# PRODUCT RECALLS

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Year</th>
<th>Number of cases</th>
<th>Isolated from product?</th>
<th>Outbreak location(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. coli O121, E. coli O26</td>
<td>2015–2016</td>
<td>63</td>
<td>yes</td>
<td>USA (24 states)</td>
</tr>
<tr>
<td>E. coli O121</td>
<td>2016–2017</td>
<td>30</td>
<td>yes</td>
<td>Canada (6 provinces)</td>
</tr>
<tr>
<td>E. coli O121</td>
<td>2017</td>
<td>6</td>
<td>yes</td>
<td>Canada (1 province: BC)</td>
</tr>
</tbody>
</table>

What is the common point?
# PRODUCT RECALLS

<table>
<thead>
<tr>
<th>Product : Flour</th>
<th>Pathogen</th>
<th>Year</th>
<th>Number of cases</th>
<th>Isolated from product?</th>
<th>Outbreak location(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Mills, Kansas City, MO</td>
<td>E. coli O121, E. coli O26</td>
<td>2015–2016</td>
<td>63</td>
<td>yes</td>
<td>USA (24 states)</td>
</tr>
<tr>
<td>Ardent Mills, Saskatoon, SK</td>
<td>E. coli O121</td>
<td>2016–2017</td>
<td>30</td>
<td>yes</td>
<td>Canada (6 provinces)</td>
</tr>
<tr>
<td>Rogers Foods, BC</td>
<td>E. coli O121</td>
<td>2017</td>
<td>6</td>
<td>yes</td>
<td>Canada (1 province: BC)</td>
</tr>
</tbody>
</table>
RISK ASSESSMENT PROCESS

1. Identify hazards
2. Assess risk
3. Control risk
4. Review controls

Modification of flour properties
Pasteurization
Stabilization
Roasting
WHY? IDENTIFY HAZARDS

- Is it ready to eat?
  - No (baked, cooked, fried)

- Has it been processed in a manner to eliminate pathogens?
  - Yes
  - No
    - Risk

- Acceptable? Validated?
  - Yes
  - No
    - Risk

- Instructions given to the consumer?
  - Yes
  - No
    - Risk

- Is there a chance he will not follow exactly the cooking process?
  - Yes
  - No
    - Safe

Modifications:
- Pasteurization
- Modification of flour properties
- Stabilization
- Roasting

ReVTech 4 in 1 Process Systems
2009, 77 people reported as sick, 30 states
Toll House Cookie Dough, Nestle
Was written not to eat before warm up
FDA found E. Coli in chocolate chip cookie dough
> 3.6 million packages recalled

Survey: 1,032 individuals in the United States
⇒ 58% of consumers have tasted refrigerated rough before baking

2010 : Nestle, USA decided using only heat-treated flours for refrigerated dough products
IS IT GOING TO EXTEND?

**Against**
- Majority still going through kill step
- Low moisture / water activity
- Low level of microorganisms
- Adverse effect on flour functionnality/quality
- Cost

**For**
- Product recalls
- Can be exposed to pathogens in soil/water or from birds/animals
- Can be impacted by wet harvest period / low harvest temperature
- Increase for wholegrain foods (might reduce obesity, cardio vascular disease, diabetes...)
- Can be eaten raw
- Can be added to foods that will not be cooked (milkshakes, ice cream...)
HOW TO CONTROL THE RISK?


Dhillon et al., 2010
Galeas, 2014

Antimicrobial agent

Wheat → Cleaning → Tempering → Milling

Chlorinated water
Ozone
Acetic / Lactic acid

Heat treatment

Wheat, 15% moisture → Heat treatment 1h, 60°C → Milling

Wheat, 15% moisture → Milling

APC: 2.43
APC: 4.69
Higher contamination on the outer layers

Miskelly & al., 2010

Higher risk for whole wheat flour

Heat treat wheat kernels outer layers

Reduce microbiological load

Mill into flour
THE REVTECH TECHNOLOGY

- Stainless steel tube
- Support structure
- Pasteurization
- Modification of flour properties
- Stabilization
- Roasting

25-35% Pasteurization

Heat treated product outlet

Product inlet

Stainless steel tube

Support structure
THE REVTECH TECHNOLOGY

1. Transportation / mixing by vibrations
   - Frequency: ~ 12 Hz
   - Amplitude: ~ 4 mm
   - Acceleration: ~ 4 g

2. Heating by direct contact with a hot surface
   - High current
   - Low voltage < 40V

3. Treatment in a confined atmosphere

Pasteurization
Modification of flour properties
Stabilization
Roasting
THE REVTECH TECHNOLOGY

- **Flowrate**: 200 lbs/h to 4,000 lbs/h
- **Temperature**: 100 to 800°F
- **Residence time**: 1 to 40 min
- **Atmosphere**: air, steam, nitrogen...

with 2 to 4 independent heating zones

- Pasteurization
- Modification of flour properties
- Stabilization
- Roasting
### REVTECH RESULTS

#### Pasteurization

- **Modification of flour properties**
- **Stabilization**
- **Roasting**

#### Product Conditions

<table>
<thead>
<tr>
<th>Product</th>
<th>Conditions</th>
<th>Residence time</th>
<th>Steam</th>
<th>Tube temperature</th>
<th>TPC (cfu/g)</th>
<th>Enterobacteria (cfu/g)</th>
<th>Yeasts &amp; Molds (cfu/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat grains</td>
<td>Raw material</td>
<td></td>
<td></td>
<td></td>
<td>140 000</td>
<td>12 000</td>
<td>1 600</td>
</tr>
<tr>
<td></td>
<td>Revtech 1</td>
<td>5 min</td>
<td>10%</td>
<td>210°F</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
</tr>
<tr>
<td></td>
<td>Revtech 2</td>
<td>5 min</td>
<td>10%</td>
<td>240°F</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
</tr>
<tr>
<td></td>
<td>Revtech 3</td>
<td>5 min</td>
<td>10%</td>
<td>265°F</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
</tr>
</tbody>
</table>

#### Average of 3 Samples

- **Reduced TPC**
- **Elimination Enterobacteria / Yeasts & Molds**
- **Safer wheat flour!**
**REVTECH RESULTS**

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<tr>
<th>Product</th>
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<th>Residence time</th>
<th>Tube temperature</th>
<th>TPC (cfu/g)</th>
<th>Enterobacteria (cfu/g)</th>
<th>Yeasts &amp; molds (cfu/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat flour</td>
<td>Raw</td>
<td></td>
<td></td>
<td>2 000</td>
<td>510</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td>Raw</td>
<td></td>
<td></td>
<td>5 000</td>
<td>1 500</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>Raw</td>
<td></td>
<td></td>
<td>2 300</td>
<td>120</td>
<td>150</td>
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<tr>
<td>Low temp</td>
<td>5 min</td>
<td></td>
<td>160°F</td>
<td>750</td>
<td>250</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>10 min</td>
<td></td>
<td></td>
<td>610</td>
<td>&lt; 40</td>
<td>&lt; 40</td>
</tr>
<tr>
<td></td>
<td>15 min</td>
<td></td>
<td></td>
<td>720</td>
<td>~ 40</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>Medium temp</td>
<td>5 min</td>
<td></td>
<td>175°F</td>
<td>430</td>
<td>&lt; 40</td>
<td>~ 40</td>
</tr>
<tr>
<td></td>
<td>10 min</td>
<td></td>
<td></td>
<td>170</td>
<td>~ 40</td>
<td>&lt; 10</td>
</tr>
<tr>
<td></td>
<td>15 min</td>
<td></td>
<td></td>
<td>150</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>High temp</td>
<td>5 min</td>
<td></td>
<td>190°F</td>
<td>&lt; 400</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
</tr>
<tr>
<td></td>
<td>10 min</td>
<td></td>
<td></td>
<td>&lt; 40</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
</tr>
<tr>
<td></td>
<td>15 min</td>
<td></td>
<td></td>
<td>&lt; 40</td>
<td>&lt; 10</td>
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</tr>
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Pasteurization works on wheat flour as well!

- But higher surface/volume ratio
- Higher contact with heat
- Might change flour properties
REVTECH RESULTS

Russo et al., 1970

1. Chlorinated flour
2. Untreated flour
3. Heat treated flour (Drum, 250°F)

Keppler, 2017

1. Untreated flour
2. Revtech 230°F, 10:45min
3. Revtech 300°F, 9:50min
REVTECH RESULTS

Flour dissolved in water, RVA tests

Easier for granules to swell?

Instability of gluten network

Temperature
Processing time

Viscosity

Rheomixer tests

Pasteurization
Modification of flour properties
Stabilization
Roasting

Keppler, 2017
WHAT ABOUT BRANS / GERMS?

- Pasteurization
- Modification of flour properties
- Stabilization
- Roasting

Raw brans / germs

Source of fibres

High enzyme activity: Lipase + Lipoxygenase

Short shelf life

About 250°F, 10 minutes

Enzyme inactivation

Shelf life
AND IF I WANT TO CHANGE COLOR/TASTE?

Temperature around 150 to 250°C / 300 to 480°F
Residence time around 10 to 20 mn

**Wheat flour - 430°F**, 0 – 3 – 6 – 9 – 15 – 30 mn

**Milled wheat bran: 430°F**, 0 – 3 – 6 – 12 – 18 – 24 mn

**Wheat germs: 350°F**, 0 – 6 – 9 – 12 – 21 mn
CONCLUSION

4 applications, 1 equipment

Great homogenity

Only gentle vibrations (no auger, belt mixer)

Works for small pieces and powders

Every machine can be validated to FDA standards
More than 120 units installed around the world
THANK YOU
Any question?

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